
NASA-16703 (March 2003)
NATIONAL AERONAUTICS NASA - KSC
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SECTION TABLE OF CONTENTS

DIVISION 16 - ELECTRICAL

SECTION 16703

OUTSIDE CABLE PLANT - COPPER

03/03

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SCOPE
- 1.3 SUBMITTALS
- 1.4 AUDIO CABLE IDENTIFICATION

PART 2 PRODUCTS

- 2.1 CABLE
- 2.2 SPLICE CONNECTORS
- 2.3 SPLICE CASES
- 2.4 MAIN DISTRIBUTION FRAME (MDF)
- 2.5 CONNECTOR BLOCKS
- 2.6 PROTECTION MODULES
- 2.7 SWITCH-THROUGH MODULES
- 2.8 TERMINAL BLOCKS
- 2.9 TERMINAL CABINETS

PART 3 EXECUTION

- 3.1 GENERAL
- 3.2 WORK IN MANHOLES AND CABLE VAULTS
- 3.3 UNDERGROUND CONDUIT
- 3.4 CABLE PLACEMENT
 - 3.4.1 Securing Cable
 - 3.4.2 Bending
 - 3.4.3 Pulling
 - 3.4.4 Set-Up
 - 3.4.5 Damage
- 3.5 CABLE SPLICING
- 3.6 BONDING AND GROUNDING SYSTEMS
- 3.7 CABLE TERMINATIONS
- 3.8 TESTING AUDIO CABLES
 - 3.8.1 Test Equipment

- 3.8.2 Section Tests
- 3.8.3 Continuity and Loop Resistance Tests
- 3.8.4 Insulation Resistance Tests
- 3.8.5 Cable Attenuation Tests
- 3.9 DATA SHEETS

-- End of Section Table of Contents --

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SECTION 16703

OUTSIDE CABLE PLANT - COPPER 03/03

NOTE: Delete, revise, or add to the text in this
section to cover project requirements. Notes are
for designer information and will not appear in the
final project specification.

This section covers requirements for the copper
cabling system for the outside cable plant.
Accordingly, this section should be tailored
carefully to suit project conditions and to meet
project requirements.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be
manually edited except to add new references.
References not used in the text will automatically
be deleted from this section of the project
specification.

The publications listed below form a part of this section to the extent
referenced:

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

7CFR 1755.403	Copper Cable Telecommunications Plant Measurements
7CFR 1755.89	RUS Specification for Filled Telephone Cables with Expanded Insulation

1.2 SCOPE

This section covers the requirements for audio pair telephone cables to be
installed as indicated on contract drawings. Building locations for each

task are indicated on contract drawings.

1.3 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01300, "Submittals," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

The following shall be submitted for approval in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

- Cable
- Splice Connectors
- Splice Cases
- MDF
- Connector Blocks
- Protection Modules
- Switch-through Modules
- Terminal Blocks
- Terminal Cabinets

SD-09 Manufacturer's Field Reports

Provide a preliminary test plan at least 30 days prior to testing.

- End-to-End Tests
- Continuity and Loop Resistance Tests
- Insulation Resistance Tests
- Cable Attenuation Tests

1.4 AUDIO CABLE IDENTIFICATION

Audio cable identification shall be numbered per KSC-STD-E-0009 (Cable Numbering, Outside Cable Plant Communications System, Standard for)

The first two lines on the ID symbol shall employ the following five characters:

First & Second Characters: Shall denote the number of hundred groups of audio pairs in the cable.

Third Character: Shall be a dash.

Fourth & Fifth Characters: Shall denote the gauge of the audio wire.

The second line of the cable ID symbol indicates the conductors are audio type cable, number, and pair count.

Example: 06-22 Identifies a 600 pair, 22 gauge audio telephone cable
 #12, with pair count 1401-2000.
 CA12:1401-2000

PART 2 PRODUCTS

2.1 CABLE

The cable shall be manufactured as Audio Telephone Cable in accordance with the requirements of 7CFR 1755.89. All cable necessary to complete the job shall be supplied by the Contractor.

2.2 SPLICE CONNECTORS

Splicing shall be accomplished utilizing Picabond individual, AMP #61292-2, or strip assembly, AMP #229917-2 or approved equal. Multiple conductor splice connectors shall not be used.

2.3 SPLICE CASES

Underground splice cases shall be suitable to house a straight, butt, or branch splice in a protective housing into which can be poured an encapsulating compound. The splice case shall be of suitable thermoplastic, thermoset, or stainless steel material with structural members as part of the mold (i.e., ribs or waffle structure). The splice cases shall be filled with an encapsulating compound which shall be re-enterable and shall not alter the chemical stability of the closure. Dry encapsulant shall not be used. Filled splice cases shall comply with REA PE-74. Quantities are indicated on drawings. AMP (or equal as approved by the Government) is a supplier of approved splice cases.

2.4 MAIN DISTRIBUTION FRAME (MDF)

The MDF to be installed in the CXT as shown on drawings, shall be single sided and shall be stand-alone. The frame shall have universal connector mounting bars suspended off each vertical, with a series of jumper rings in between. The frames shall include guard rails, end bars, and a copper ground bar across the base. The frame verticals shall be on 8" centers.

The frame shall be a welded construction of cold rolled angle, channel and bar steel, phosphatized and bonderized for corrosion and oxidation resistance. The finished frame shall have multiple coats of "telephone gray" baked on enamel as the final protective finish.

2.5 CONNECTOR BLOCKS

Connector blocks shall be Reliable Electric's Part No. R399A A40D or NT Cook Electric Part No. C-38860240D or AT&T 310A2/310B2 or approved equal. All new connector blocks shall be provided fully equipped with protection modules switch through modules as described below.

2.6 PROTECTION MODULES

Protection modules shall be of the three-electrode, five male pin, heavy duty gas tube type or solid-state equivalent type and shall be REA and UL listed. Protection modules shall have both voltage overload and sneak current protection.

2.7 SWITCH-THROUGH MODULES

Switch-through modules shall be used only at the CXT locations to open/close the circuits at the connector blocks on the CXT frame. They shall fit within the connector blocks in the same manner as do the protection modules. The number of switch-through modules provided shall be as shown on the drawings.

2.8 TERMINAL BLOCKS

Terminal blocks shall be 8 x 26 wire wrap/wire wrap line terminal blocks. The terminal blocks shall be provided at the CXT distribution frame only, in quantities shown in drawings.

2.9 TERMINAL CABINETS

Terminal cabinets to be mounted on walls or plywood backboards, shall be 610mm x 610mm x 914mm 24" x 24" x 8" D or 914mm x 914mm x 203mm 36" x 36" x 8" D as required by the drawings, and shall be equipped with a 19mm 3/4" plywood backboard. This backboard shall be painted with flame retardant, prior to installation into the box. Protected entrance terminals shall be installed to terminate the required number of copper pairs. These terminals shall be 3M #4488 type or approved equal.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall:

Ensure that all Contractors and subcontractors performing on-site work provide personnel who have experience and knowledge required to perform the various tasks for installation of the Audio Cable System.

Ensure that installers and fabrication personnel are familiar with the requirements of the technical specifications and other pertinent referenced documents of the contract.

Ensure that quality control personnel who inspect cabling and wiring installations and assembly work are appropriately qualified in the assigned work.

Ensure that communication cable splices and terminations shall be made by journeyman cable splicers who have experience performing the same such duties.

Ensure that cable testing personnel shall be experienced and appropriately qualified.

The qualifications for all management personnel responsible for the following work areas shall be verified by personnel resumes furnished by the Contractor, prior to construction.

- Audio Telephone Cable Installation
- Audio Telephone Cable Splicing
- Audio Telephone Cable Testing
- Quality Control
- Project Manager/Lead

The qualifications for all personnel who will perform the work defined above shall be verified by personnel resumes, furnished by the Contractor at least thirty (30) days prior to any work initiation.

Each individual who is to perform cable splicing may be required to perform a minimum of one acceptable sample splice and termination. Sample splices shall not be incorporated in the job.

3.2 WORK IN MANHOLES AND CABLE VAULTS

The Contractor shall be responsible for ensuring that safe operating procedures are followed, work equipment is adequate, and personnel have received proper training. All atmospheric tests will be conducted by others prior to Contractor personnel entering a manhole or vault. Safety equipment will be inspected and approved by an authorized representative of the Contracting Officer.

Smoking will not be permitted in or around open manholes. Open manholes shall be protected by fences, railings, signs, flags, or lights, as applicable. Body static electricity that may have accumulated shall be discharged to ground prior to personnel contact with manhole covers. Removal of manhole covers shall be performed by two men using hooks and employing proper lifting techniques. All manhole covers in the immediate vicinity of the duct system where work is to be performed shall be removed to permit adequate ventilation.

A burn permit authorizing the use of torches, furnaces, and other open flame, heat-generating devices shall be obtained prior to use of such devices (use shall not be permitted in manholes).

Each time work is begun, excessive water shall be removed or pumped from the manhole vault or duct run as required, prior to personnel entrance.

A manhole entry permit shall be required for every manhole entry. This permit will be issued by NASA or one of its Contractors.

Vapor tests shall be performed to ensure that the presence of explosive gases is below dangerous concentration levels (less than 0.25 percent by volume).

Above environmental tests shall be performed each time work is started or

at the initial crew change and shall be repeated in a time interval not to exceed 8 hours. If prolonged forced ventilation is required, the time interval for additional tests shall not exceed 2 hours.

Two persons shall be present during manhole operations; one man enters the manhole, the other shall remain outside. The outside man shall be equipped with a communication device to call for help if necessary.

Blowers shall be operated continuously while work is performed and until work is completed.

Blowers shall not be placed in the manhole or cable vault, but shall be located on the surface at a distance not less than 5 feet from the open manhole or cable vault to assure a safe operating atmosphere. Engine driven equipment shall be located downwind from manholes and shall have ducted exhausts away from manhole opening.

Ladders of the proper length and type (wood or fiberglass) shall be used for entry into manholes.

3.3 UNDERGROUND CONDUIT

The duct or conduit assignment for individual cables shall be as indicated and field verified. Cables shall not be placed in ducts or conduits other than those indicated without Government approval.

All ducts to be used shall be rodded, cleaned, and tested for alignment as specified in AFTO 3W3-10-12. Mechanical equipment with winch lines shall be used at both ends of the section to be rodded, and allow the line to be worked back and forth through the ducts. The KSC duct system does not contain pulling lines and may contain orangeburg material. Some sections may require mechanical rodding equipment with cutting tools and water pressure equipment to clean and align the defective or blocked orangeburg duct as necessary.

3.4 CABLE PLACEMENT

Adequate care shall be exercised when handling and storing reels of cable to prevent damage to the cable. Cable with dents, flat spots, or other sheath distortions shall not be installed.

3.4.1 Securing Cable

Immediately after cable placement, temporary tags with the cable number and pair count shall be attached to each end of each cable section.

Cables and equipment shall be supported and secured as indicated. Where the specific method of support is not shown, adequate supports and fasteners shall be used to secure cables and equipment in position. Non metallic supports and fasteners shall be provided in manholes and vaults. All cables and equipment installed in exterior locations shall be secured so that they can not be dislodged or damaged by winds up to 125 miles per hour.

Cable splices shall be housed in a splice case installed along the cable route, mounted in the duct system cable vaults and manholes. The splice case shall provide a protected environment for the splices and shall maintain the moisture barrier properties of the cable. Cable splices in duct or conduit sections are prohibited.

3.4.2 Bending

Caution shall be used when bending cable to avoid kinks or other damage to the sheath. The bend radius shall be as large as possible, with a minimum of not less than 10 times the outer diameter (O.D.) of the cable. Minimum radii shall be increased when necessary to meet cable manufacturer's recommendations. Bending operations in manholes and vaults shall be performed in accordance with the procedures and instructions of the manufacturer. Cable bending shoes shall be used at duct or conduit ends when bending cable exiting a duct or conduit. The bending shoes shall remain in place until racking, splicing, and tying is completed. Cables shall not rest against the edge of the duct or conduit mouth.

3.4.3 Pulling

When a duct or conduit has an appreciable curve, and conditions permit, the cable reel shall be set up at the end nearest the bend and the cable pulled from the opposite end. Otherwise, the cable may be pulled from the most convenient end.

Pulling lines shall be attached to cable ends fitted with factory-installed pulling eyes. Cables not equipped with a pulling eye shall have the pulling line attached to the cable end by means of a cable grip. Core hitches shall not be used.

Rigging shall be set up at the pulling end so that the pulling line and cable enter or exit on a line parallel with the duct or conduit to prevent either from rubbing against the edge or mouth. Cable ends shall not be pulled around sheave wheels. When the end slack for proper racking and splicing can not be obtained with the pulling line still attached to the end of the cable, a split cable grip may be used to obtain the necessary slack.

3.4.4 Set-Up

Cable reels shall be located and aligned so that the cable is paid off the top of the reel into the duct or conduit in a long, smooth bend, without twisting. Cable shall not be pulled from the bottom of a reel or subjected to reverse bends from those formed by factory reeling. A cable feeder guide of proper size shall be used at the mouth entrance. Unterminated cables shall be laid in the specified routing and location as indicated.

Unterminated cable ends shall be cleared, capped, and sealed. The lubricant shall be compatible with, and intended for use with, Stalpeth sheathed cables. Soap and grease lubricants are prohibited.

All equipment and the pulling set-up shall be carefully checked to minimize interruptions once pulling begins. Insofar as possible, the cable shall be

pulled without stopping until the required amount of cable has been placed.

If for any reason the pulling operation must be halted before the pull is complete, the tension of the pulling line shall not be released. When pulling is resumed, the inertia of the cable shall be overcome by increasing the tension in small steps a few seconds apart until the cable is in motion. The cable shall be paid off the reel by rotating the reel in the feed direction and not stripped off the reel by pulling.

3.4.5 Damage

The cable shall be carefully inspected for sheath defects or other irregularities as it is paid off the reel. If defects are detected, pulling shall stop immediately and the cable section shall be repaired or replaced at the discretion of the Contracting Officer. A system of communications, visual or otherwise, shall be maintained between feed and pulling locations so that pulling can be stopped instantly, if necessary. "Pull-thrus" (continuous cable through two or more duct sections without splicing in an intermediate manhole) may be made with the approval of the Contracting Officer.

Appropriate size split grip, manhole sheaves, sheave shackles, and increased lubricant shall be used, as well as exercising caution during the pulling operation, to avoid excess slack and prevent kinking or any damage to the cable. Cables in the intermediate manhole shall be suitably racked at the time of installation, with no sheath defects or other irregularities.

Cable ends pulled into manholes or vaults that are not to be racked or otherwise permanently positioned, shall immediately be tied in fixed positions with ties to prevent damage to the cables and to provide adequate working space. After final racking and splicing, plastic sheathed cables in manholes and vaults shall be secured in place with lashed cable supports. When securing cables and details are not indicated, the cables shall be secured in a manner that will maintain the cables in the required position without damage to the cables.

3.5 CABLE SPLICING

Cables shall be spliced in accordance with the manufacturer's recommendation. Conductors shall remain in their correct color sequence or groups as indicated.

Undetermined cables shall be installed as indicated. Unterminated or dead cable pairs shall be connected through to other unterminated or dead cable pairs, cleared at each end and tested according to other portions of this specification.

For each copper splice point, after splice completion and prior to splice case installation and , the Government will inspect splice and approve workmanship.

3.6 BONDING AND GROUNDING SYSTEMS

Cable shall be grounded as specified in Section 16065, "Secondary Grounding," unless otherwise indicated. The overall shield of all cables

installed shall be grounded at each terminal point or bonded across all splice points and to a manhole bonding ribbon.

3.7 CABLE TERMINATIONS

Terminate cables as shown on contract drawings. Installation shall not impede future installations and shall not damage existing cables.

3.8 TESTING AUDIO CABLES

All cable pairs shall be tested after installation. Electrical acceptance testing for cables under this specification shall be in accordance with 7CFR 1755.403. Field tests shall be witnessed by the Government. Five (5) working days notice prior to performing each test shall be given. The measured electrical parameter shall conform to the manufacturer's stated specification. Sample forms included at the end of this section may be used. Test forms and procedures shall be included in the test plan. All test anomalies shall be corrected.

When splicing audio cable, the Contractor may at his own discretion, test cable sections between splice cases, prior to filling splice cases with encapsulant. However, care shall be exercised so that unfilled splice cases temporarily stored in manholes during testing shall not be subjected to ingress of water which may be found in manholes.

3.8.1 Test Equipment

Test equipment shall be of sufficient accuracy, quality, and quantity to perform specified tests.

Insulation resistance tests shall be performed with a 500-volt insulation resistance test set.

The use of auxiliary test boards, panels, or other special equipment to facilitate the testing procedure is optional, subject to approval. The equipment shall not cause any appreciable change in the actual cable measurements being made and shall be designed to permit ready verification of the internal circuits and components.

All test equipment shall be calibrated by a certified testing company every eighty (80) days, unless required sooner because of damage or inaccuracy. Standards for calibrating shall be as listed by the National Bureau of Standards, and each item of test equipment shall display a current calibration sticker.

3.8.2 Section Tests

End-to-end tests for pair identification, true pair, shorts, opens, grounds and splits shall be made and each conductor condition recorded separately. Tests shall be conducted per 7CFR 1755.403.

3.8.3 Continuity and Loop Resistance Tests

Continuity and loop resistance tests of each pair shall be made and

recorded. Tests shall be conducted per 7CFR 1755.403. Sample test forms are included at the end of this section.

3.8.4 Insulation Resistance Tests

End-to-end tests of each conductor to all other conductors and all conductors to ground (shield) shall be made and recorded. Tests shall be conducted per 7CFR 1755.403. Sample test forms are included at the end of this section.

3.8.5 Cable Attenuation Tests

All outside plant cables for T1 type carriers shall be tested for attenuation at a frequency of 772 Khz in accordance with 7CFR 1755.403.

3.9 DATA SHEETS

SAMPLE DATA FORM, PARAGRAPH 3.8.2/3.8.3

CONTINUITY AND LOOP RESISTANCE TEST

CONTRACT

NAME/NUMBER: _____

CABLE NO.: _____ CABLE COUNT: _____ CABLE TYPE: _____

CABLE LOCATION: FROM: _____ TO: _____

CABLE LENGTH: _____ FT. GAUGE: _____

CONTINUITY: OUTER SHEATH: _____ OHMs NO. SPLICES: _____

PAIR	**	LOOP. RES.	PAIR	**	LOOP RES.
NUMBER		(OHMs)**	NUMBER		(OHMs)**

** INDICATE SHORT, OPEN, CROSS, OR GROUND

TEST CONDUCTOR: _____ DATE: _____

CONTRACTING OFF. REP.: _____ DATE: _____

SAMPLE DATA FORM, PARAGRAPH 3.8.4

INSULATION RESISTANCE TEST

CONTRACT

NAME/NUMBER: _____

CABLE NO.: _____ CABLE COUNT: _____ CABLE
TYPE: _____

CABLE LOCATION: FROM: _____
TO: _____

CABLE LENGTH: _____ FT.
GAUGE: _____ AWG

CONTINUITY: OUTER SHEATH: _____ OHMs NO.
SPLICES: _____

PAIR NUMBER	TIP OR RING	INS. RES. (MEGOHM)	PAIR NUMBER	TIP OR RING	INS. RES. (MEGOHM)
----------------	----------------	-----------------------	----------------	----------------	-----------------------

	Tip			Tip	
	Ring			Ring	
	Tip			Tip	
	Ring			Ring	
	Tip			Tip	
	Ring			Ring	
	Tip			Tip	
	Ring			Ring	
	Tip			Tip	
	Ring			Ring	
	Tip			Tip	
	Ring			Ring	
	Tip			Tip	
	Ring			Ring	
	Tip			Tip	
	Ring			Ring	
	Tip			Tip	
	Ring			Ring	

TEST CONDUCTOR: _____ DATE: _____

CONTRACTING OFF. REP.: _____ DATE: _____

-- End of Section --